Inter-organizational information systems adoption for service innovation in building sector

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A B S T R A C T

The building sector has experienced a significant decline in recent years in Spain and Europe as a result of the financial crisis that began in 2007. This drop accompanies a low penetration of information and communication technologies in inter-organizational oriented business processes. The market decrease is causing a slowdown in the building sector, where only flexible small and medium enterprises (SMEs) survive thanks to specialization and innovation in services, which allow them to face new market demands. Inter-organizational information systems (IOISs) support innovation in services, and are thus a strategic tool for SMEs to obtain competitive advantage. Because of the inherent complexity of IOIS adoption, this research extends Kurnia and Johnston's (2000) theoretical model of IOIS adoption with an empirical model of IOIS characterization. The resultant model identifies the factors influencing IOIS adoption in SMEs in the building sector, to promote further service innovation for competitive and collaborative advantages. An empirical longitudinal study over six consecutive years using data from Spanish SMEs in the building sector validates the model, using the partial least squares technique and analyzing temporal stability. The main findings of this research are the four ways an IOIS might contribute to service innovation in the building sector. Namely: a) improving client interfaces and the link between service providers and end users; b) defining a specific market where SMEs can develop new service concepts; c) enhancing the service delivery system in traditional customer–supplier relationships; and d) introducing information and communication technologies and tools to improve information management.

1. Introduction

Inter-organizational information systems (IOISs) are information systems that two or more companies share (Kumar & van Dissel, 1996). Some examples of IOISs are Supply Chain Management (SCM), and Collaborative Planning Forecasting and Replenishment (CPFR) systems. The concept of IOIS consists of the general idea of a collaborative system for supply chain management, enabling the flow of information between enterprises for competitive and collaborative advantages (Criado-Fernández, 2000).

IOIS adoption requires cooperation and collaboration among trading partners, and therefore depends on the relationships between the business parties (Kim, Park, Ryoo, & Park, 2010). Facing the inherent complexity of the adoption process, Kurnia and Johnston (2000) developed a theoretical model to study IOIS adoption. Further studies use this model as a starting point for research (Ali, Kurnia, & Johnston, 2008).

Recent research on SCM systems' design in the building sector looks to improve process efficiency because flexible, specialist small and medium enterprises (SMEs) have better chances of survival (Carbonell-Ureña, 2012). This specialization of SMEs is the cause of the current business focus on building small houses, restorations, or complete renovations (BIC-Galicia, 2010). This kind of specialization is an example of an innovation in services by adapting to new market demands.

The ultimate goal is to design an IOIS for the SMEs in the building sector to help them cope with the financial crisis. Unfortunately, however, the low penetration of Information and Communication Technologies (ICTs) in inter-organizational oriented business processes in this sector hinders the attainment of this goal (Ecorys, 2008). Therefore, determining which factors contribute to IOIS adoption in this sector is a key issue for improving the efficiency of SMEs.

The remainder of this paper has the following structure. Section 2 presents the research framework to analyze the contribution of these factors, Section 3 explains the methodology of the empirical study, Section 4 discusses the main findings, and, finally, Section 5 lays out the main conclusions of this research.

2. Research framework

Following the arrival of the financial crisis, the trend in the literature on ICTs in the building sector is to seek how to improve information management as a tool to optimize resources and service innovation (Carbonell-Ureña, 2012). Authors mainly propose the deployment of SCM systems in SMEs to cope better with the financial crisis. Some potential benefits that SMEs in the building sector may achieve are: time savings, reducing costs and error rates, and improvements in project efficiency and control (Carbonell-Ureña, 2012; Chung, Kumaraswamy, & Palaneeswaran, 2009).

IOIS adoption requires a commitment from participating firms to work collaboratively in order to achieve common objectives and goals. Because of the inherent complexity of the IOIS adoption process, authors employ different approaches to analyze the influence of enterprise characteristics on IOIS adoption (Chwelos, Benbasat, & Dexter, 2001; Ham & Johnston, 2007; Koch, 2005; Kurnia & Johnston, 2000; Nøkkentved, 2009). These approaches stress the importance of inter-organizational relationships, but no empirical validation supports this statement. This absence of empirical evidence is especially true in the building sector, which leads to the formulation of the following research questions. *Could an empirical model analyze the key factors contributing to IOIS adoption in the building sector? If so, what is the specific contribution of each factor?*

2.1. IOIS adoption model

Kurnia and Johnston (2000) classify IOIS adoption variables following a factor approach and a process approach, suggesting dynamic interactions among the players in the supply chain. They propose three different variables to characterize IOIS adoption.

- *Organizational capabilities* (*OC*) represent the organizational factors that relate to the intention to adopt information systems.
- *Inter-organizational environment* (*IE*) considers the supply chain structure or the external environment of the organization that may affect the decision to adopt IOIS.
- *Perceived benefits* (*PB*), which Kurnia and Johnston (2000) refer to as *Nature of technology*, are the potential benefits for organizations from adopting IOIS.

Fig. 1 illustrates how this model proposes causal links between these variables and the outcome construct, *intention to adopt IOIS* (*ITA*), as a predictor of IOIS system usage.

This model enhances understanding of how organizations adopt IOIS, but is unsuitable for empirical research (Ali et al., 2008). Ali et al. (2008) cite the need to operationalize model variables for quantitative analysis and empirical validation, which is precisely what this study sets out to do.

2.2. IOIS characterization model

The IOIS Characterization Model (ICM) shows the operationalization that the discussion above alludes to, and characterizes IOIS according to how an enterprise performs across a set of features or variables within four categories or dimensions (Orero-Giménez & Criado-Fernández, 1999).

- The *strategic* (*S*) dimension considers IOIS as a source of competitive advantage, and encompasses a new value proposition for services.
- The *collaborative* (*C*) dimension empowers the creation of communication channels between companies–suppliers and customers–and the extension of the business value chain to larger geographic areas.
- The *organizational* (*O*) dimension reflects the degree to which IOIS represents a global organization, including interdependencies among participants.
- The *technological* (*T*) dimension covers the ICT features, enabling companies to achieve greater efficiency in information processing.

Criado-Fernández (2000) validates the ICM and proves that IOIS characteristics contribute to improving enterprise virtualization, thus promoting IOIS adoption. Fig. 2 shows the four dimensions of the ICM. These dimensions match up to the four dimensions, or areas, in den Hertog's (2000) model for service innovation; that is, service concept, service delivery system, client interface, and technological options (Pereira-Rama, Chaparro-Peláez, & Agudo-Peregrina, 2012). Therefore, these features correspond to the feasible ways of achieving service innovation through IOIS implementation and adaptation of processes to new market demands.

2.3. Research model design

Both models–Kurnia and Johnston's (2000) IOIS adoption model, and the ICM–have the same theoretical foundations: the analysis of the impact of an IOIS in supply chain management, following Holland's (1995) work, and Markus and Robey's (1988) research on organizational change. The models do, however, differ in terms of their approach to explaining the analysis of IOIS adoption, employing a factor approach and an information system characterization approach, respectively. Therefore, in this research, the model of IOIS adoption combines the theoretical approach of Kurnia and Johnston's (2000) model with the empirical approach of the ICM, in order to analyze the key factors contributing to IOIS adoption in the building sector.

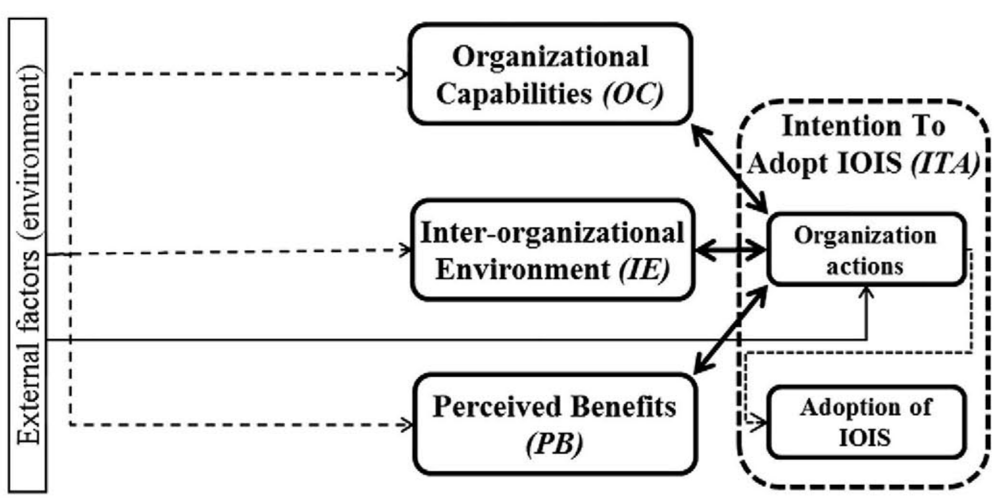

Fig. 1. IOIS adoption model.

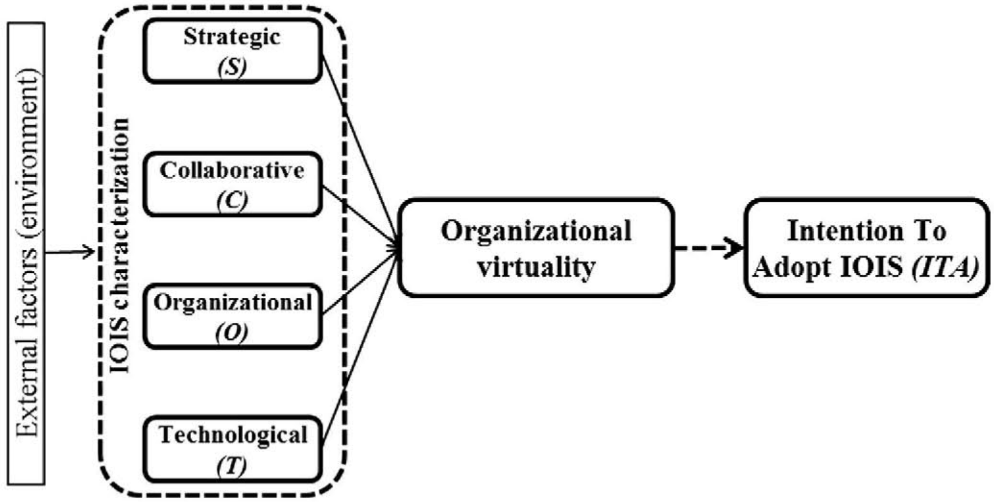

Fig. 2. IOIS characterization model.

Fig. 3 shows the research model, which depicts the relationships between the four IOIS characterization features (*strategic*, *collaborative*, *organizational*, and *technological*) and the three IOIS adoption factors (*organizational capabilities*, *inter-organizational environment*, and *perceived benefits*). Fig. 3 also illustrates the links between IOIS adoption factors and the intention to adopt IOIS, contingent on three research hypotheses.

H1. *Better SME organizational capabilities predict greater intention to adopt IOIS in the building sector.*

H2. *Higher predisposition of inter-organizational environment in the supply chain structure predicts greater intention to adopt IOIS in the building sector.*

H3. *Higher perceived benefits to SMEs in the building sector predict greater intention to adopt IOIS.*

The research model is useful for analyzing and measuring which IOIS features and adoption factors are important for building sector SMEs to adopt IOIS. These features could promote SMEs' service innovation through the implementation of processes that are able to meet new market demands.

3. Method and results

According to methodology from previous studies in technology acceptance and adoption (Chwelos et al., 2001), a partial least squares (PLS) approach allows empirical testing of the research model. PLS maximizes the explained variance of the endogenous latent variables and unrestrictedly handles both reflective and formative measures (Chin, 1998). PLS is suitable for this research because of its ability to perform distribution-free soft modeling. The software tool for this study is SmartPLS 2.0 (M3) (Ringle, Wende, & Will, 2005).

The model has one endogenous construct (*ITA*), and three second-order exogenous constructs (*OC*, *IE*, *PB*). Each second-order construct has four sub-constructs (*S*, *C*, *O*, *T*). In this study, all of the sub-constructs are reflective first-order constructs, while the remaining latent variables are formative constructs. The distinction between formative and reflective constructs is sometimes unclear, but prior literature on the topic supports this modeling approach (Cepeda-Carrión & Roldán-Salgueiro, 2004; Chwelos et al., 2001; Coltman, Devinney, Midgley, & Venaik, 2008). The use of reflective first-order constructs and formative second-order constructs means that the weights of first-order constructs are a representation of the importance of their

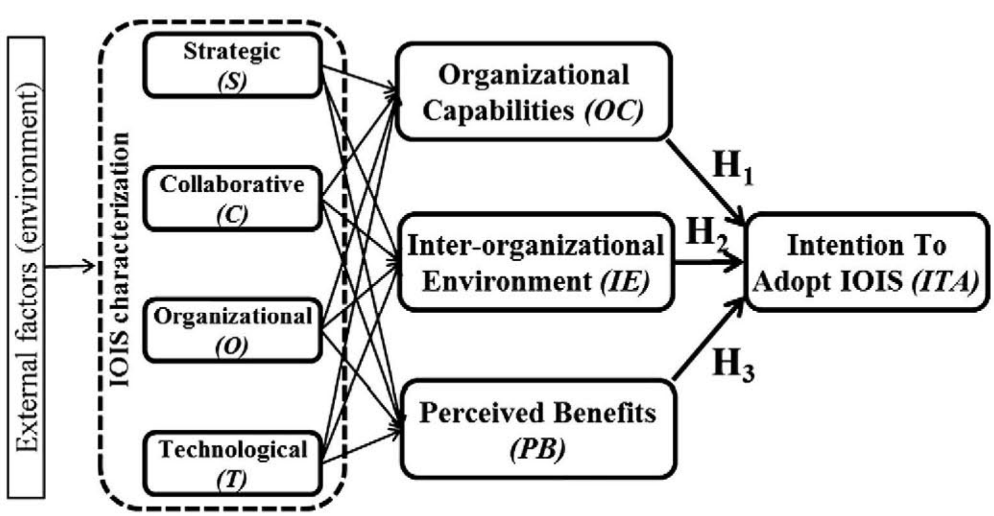

Fig. 3. Research model.

impact on the second-order constructs (MacKenzie, Podsakoff, & Podsakoff, 2011).

3.1. Procedure and longitudinal study

A longitudinal study of six consecutive years tests and validates the research model, providing information about changes over time and stability of results, as Kurnia and Johnston (2000) suggest.

The stratified sample in this study includes the five different types (cohorts) of companies in the building sector–developers, designers, contractors, builders and home automation integrators–from the ARDÁN-Galicia (2003–2013) enterprise directory. The number of random samples representing each type of agent is proportional to their number in the overall population in the area of A Coruña (Spain). Sample representativeness ensures a confidence level of 95%, and a maximum error level of 10%. The sample sizes for each year are: 88, 116, 124, 133, 140, and 142, from cohorts of the overall population of 894, 1070, 1101, 1080, 1179, and 1160 companies, respectively.

Responding companies report average annual revenues of 3.2 million euros and average annual staff of 25 employees. After personal interviews with CEOs and ICT managers of each company, these company representatives must complete a structured questionnaire. The questionnaire adapts items from the ICM (Criado-Fernández, 2000) to the building sector. The final questionnaire consists of 47 five-point Likert-type questions.

3.2. Measurement model assessment

PLS obtains information about item reliability from the values of the factor loadings of each latent variable's indicator. PLS also analyzes construct reliability and convergent and discriminant validity of the model (Cepeda-Carrión & Roldán-Salgueiro, 2004).

The values in Table 1 confirm item reliability because all items have factor loadings (λ) that are higher than the acceptable threshold of 0.60, in actual fact exceeding the 0.70 limit value (Nunnally, 1978). Note that the depuration process excludes IE_T from the analysis. The analysis corroborates convergent validity, with constructs' composite reliability (ρ_c) greater than 0.85, and average variance extracted (AVE) that is higher than 0.72, well over the cutoff values of 0.7 (Hair, Anderson, Tatham, & Black, 1998) and 0.5 (Fornell & Larcker, 1981), respectively. The results also confirm discriminant validity, with the square root of AVEs higher than bivariate correlations between each construct, thus assuring that the indicators are correctly measuring their correspondent construct and not the others (Gefen & Straub, 2005).

3.3. Temporal stability

The test–retest score is an index of temporal stability that uses Pearson's correlation coefficient for the model's items (Campbell & Stanley, 1966). The test–retest scores ($r_{test,retest}$) for each subsequent year–0.98, 0.97, 0.81, 0.71, and 0.70–confirm the temporal stability of the model. These figures show a very good temporal reliability for a six-year longitudinal study.

3.4. Structural model assessment

PLS calculates the amount of explained variance of the construct from the predictor variables, as well as the structural path coefficients and their statistical significance. A bootstrap resampling procedure with 500 subsamples analyzes the significance of interaction effects (Chin, 1998). Table 2 shows the structural model assessment for the longitudinal study.

The analysis of the structural model shows significant paths (β) throughout the study for the relationships: $OC \rightarrow ITA$, $PB \rightarrow ITA$; $OC_O \rightarrow OC$; $IE_S \rightarrow IE$; $PB_S \rightarrow PB$, $PB_C \rightarrow PB$, and $PB_O \rightarrow PB$–most at the $p < 0.001$ level–(note that $IE \rightarrow ITA$ is non-significant). From the observation of path coefficients (β), all significant paths have positive values greater than 0.2 (Chin, 1998), except the relationship $PB_C \rightarrow PB$, which is significant but negative.

The model offers a very good explanation of *OC*, *PB*, and *ITA*, with values from 52 to 98% of explained variance (R^2) over the six-year period. In particular, R^2 values for *ITA* range from 58 to 88%, while values for *IE* barely reach 50%. In all cases, the explained variance is above 10%, so the complete model is well defined (Falk & Miller, 1992).

Stone–Geisser's (Q^2) test analyzes the predictive relevance of the model using a blindfolding procedure with a distance omission of 7. All cross-validated redundancy measures are positive for all years–with figures between 0.30 and 0.77–and the model therefore has predictive relevance.

3.5. Main findings and hypothesis testing

The relationships in the research model yield four main findings.

- *Intention to adopt IOIS*: $OC \rightarrow ITA$ and $PB \rightarrow ITA$ are significant over the longitudinal study period, supporting H_1 and H_3. The high contribution of OC_O, PB_S, and PB_O implies that organizational and strategic IOIS features are the main drivers of IOIS adoption in the building sector.
- *Inter-organizational environment*: $IE \rightarrow ITA$ is non-significant; this finding does not support H_2. Nevertheless, strategic IOIS features–relationship $IE_S \rightarrow IE$–contribute the most to inter-organizational environment.
- *Collaborative IOIS features*: $PB_C \rightarrow PB$ is significant but negative, and therefore the collaborative features of IOIS contribute negatively to IOIS adoption.
- *Technological IOIS features*: $PB_T \rightarrow PB$ is non-significant; thus, the SMEs in the building sector are overlooking ICTs as a source of potential benefits.

The following section discusses and explains these findings.

4. Discussion of main findings

The percentage of companies already using IOIS grows from 0 to 15% over the six-year period. The scope of IOIS implementation varies among these companies, but the figures and the trend are noteworthy. The research model allows the analysis of which factors contribute most to IOIS adoption and which IOIS features enhance competitive advantage in SMEs in the building sector.

The four dimensions representing the features of IOIS match up to the areas for service innovation in den Hertog's (2000) model (Pereira-Rama et al., 2012). Therefore, IOIS dimensions support service innovation in each corresponding area, so IOIS features promote IOIS adoption, and therefore IOIS may contribute to service innovation.

4.1. Intention to adopt IOIS

The intention to adopt IOIS in the SMEs in the building sector depends on the capabilities of the SME and the perceived benefits from IOIS implementation. In particular, organizational and strategic features of IOIS promote IOIS adoption. This finding is consistent with the research framework and with recent literature on IOIS adoption–EDI, B2B marketplaces or SCM–(Carbonell-Ureña, 2012; Chwelos et al., 2001).

In other words, this study confirms that organizational-level efforts to obtain competitive advantage through improving client interfaces have a relation with the intention to adopt IOIS in SMEs in the building sector. SMEs view IOIS as a way to improve the relationship between the service provider and end users. Thus, IOIS enhances innovations that aim to improve client engagement in service provision. A correspondence therefore exists between this finding and the client interface

Table 1
Measurement model assessment and discriminant validity of formative constructs.

Item			Value
OC	**Organizational capabilities**	$\boldsymbol{\rho_c}$	**0.92**
	The company improves…	**AVE**	**0.74**
OCl	*Delivery time*	λ	0.71
OC2	*Product or service time to market*	λ	0.90
OC3	*Ease of adaptation and organization*	λ	0.92
OC4	*Creating collaborative relationships*	λ	0.90
OC_s	OC's strategic features	ρ_c	0.97
	The company looks for…	AVE	0.91
OC_s1	*Cooperation with competitors*	λ	0.95
OC_s2	*Complementary cooperation*	λ	0.96
OC_s3	*Customer-seller cooperation*	λ	0.95
OC_c	OC's collaborative features	ρ_c	0.93
	The company looks for…	AVE	0.87
OC_c1	*Relationship standardization*	λ	0.95
OO_c2	*Long-term relationships*	λ	0.91
OC_o	OC's organizational features	ρ_c	0.94
	The company looks for…	AVE	0.84
OC_o1	*Commercial heterogeneity*	λ	0.91
OC_o2	*Third-party shared constraints*	λ	0.94
OC_o3	*Third-party task sharing*	λ	0.90
OC_T	OC's technological features	ρ_c	0.91
	The company looks for…	AVE	0.72
OC_T1	*Cooperative technologies*	λ	0.82
OC_T2	*Information availability*	λ	0.88
OC_T3	*Supporting decision-making*	λ	0.89
OC_T4	*Network Internet standards*	λ	0.82
IE	**Inter-organizational environment**	$\boldsymbol{\rho_c}$	**0.90**
	The sector empowers…	**AVE**	**0.70**
IE1	*Location and decentralization*	λ	0.79
IE2	*Importance of quality*	λ	0.80
IE3	*Importance of design*	λ	0.89
IE4	*Importance of customer service*	λ	0.86
IE_S	IE's strategic features	ρ_c	0.94
	The sector follows…	AVE	0.85
IE_S1	*Environment tendencies*	λ	0.88
IE_S2	*Digital society tendencies*	λ	0.94
IE_S3	*ICT availability and use*	λ	0.94
IE_c	IE's collaborative features	ρ_c	0.94
	The sector looks for…	AVE	0.80
IE_c1	*National range market relationships*	λ	0.97
IE_c2	*Global range market relationships*	λ	0.93
IE_c3	*Frequent partnerships in market*	λ	0.83
IE_c4	*Long-term partnerships in market*	λ	0.85
IE_o	IE's organizational features	ρ_c	1.00
	The sector follows…	AVE	1.00
IE_o1	*Environmental influences*	λ	1.00
PB	**Perceived benefits**	$\boldsymbol{\rho_c}$	**0.96**
	The technology improves…	**AVE**	**0.84**
PB1	*Delivery time*	λ	0.84
PB2	*Product's time to market*	λ	0.94
PB3	*Organizational flexibility*	λ	0.94
PB4	*Cost savings*	λ	0.96
PB5	*Decentralization*	λ	0.89
PB_S	PB's strategic features	ρ_c	0.92
	The technology supports…	AVE	0.79
PB_S1	*Assessment of new technologies*	λ	0.85
PB_S2	*Decentralized decision-making*	λ	0.92
PB_S3	*Collaborative learning*	λ	0.90
PB_C	PB's collaborative features	ρ_c	0.92
	The technology supports…	AVE	0.86
PB_C1	*National market relationships*	λ	0.87
PB_C2	*Global market relationships*	λ	0.96
PB_o	PB's organizational features	ρ_c	0.92
	The technology supports…	AVE	0.80
PB_o1	*Teamwork promotion*	λ	0.94
PB_o2	*Continuous improvement*	λ	0.92
PB_o3	*Search of business objectives*	λ	0.88
PB_T	PB's technological features	ρ_c	0.90
	The technology supports...	AVE	0.75
PB_T1	*Information standardization*	λ	0.80
PB_T2	*Information proximity*	λ	0.87
PB_T3	*Handling of scattered information*	λ	0.92

(continued on next page)

Table 1 (*continued*)

Item			Value
ITA	**Intention to adopt IOIS**	ρ_c	**0.96**
		AVE	**0.88**
ITA1	*Resistance to use IOIS (reverse coded)*	λ	0.93
ITA2	*Priority of use of IOIS*	λ	0.96
ITA3	*Frequency of use of IOIS*	λ	0.92

	ITA	*OC*	*IE*	*PB*
ITA	(0.94)			
OC	0.78	(0.86)		
IE	−0.21	−0.07	(0.84)	
PB	0.55	0.03	−0.34	(0.92)

Data in bold stand for the composite reliability (ρ_c) and average variance extracted (AVE) values of the second-order constructs (OC, IE, PB) and the endogenous construct (ITA).

dimension in den Hertog's (2000) model for service innovation, whereby suppliers adapt service provision to new market demands.

4.2. Inter-organizational environment

Inter-organizational environment in the building sector (i.e., the supply chain structure that presses SMEs to adopt a specific market model and obey its rules) does not contribute to IOIS adoption despite the large weight of influence of the strategic features on the supply chain structure. Collaborative and organizational IOIS features emerge as non-significant for inter-organizational environment, but the strategic features of IOIS have a very important role in inter-organizational environment for SMEs in the building sector. This finding contradicts Chwelos et al. (2001), who conclude that inter-organizational environment contributes to the intent to adopt EDI.

SMEs feel that the sector follows the social trends; that is, trends emerging from the environment and the digital society, as well as ICT availability and use. Therefore, building sector SMEs experience pressure to follow social trends. This finding is in line with the above idea that only flexible, specialist SMEs stay afloat in a downward market. Nevertheless, this pressure does not necessarily lead to IOIS adoption in SMEs.

The practical implications of this finding suggest the need for companies to find a specific niche market, within the traditional sector market, in order to survive. In that case, pressures from the traditional sector or from the inter-organizational environment may not have a significant influence when defining a strategy for survival. On the contrary, the concept of innovation in services to meet new market demands–such as businesses focusing on building small houses, restorations or complete renovations–may prove a successful strategy. Therefore, traditional rules in the building sector are changing, on account of the specialization of SMEs in an attempt to survive.

4.3. Collaborative IOIS features

Collaborative IOIS features contribute negatively to IOIS adoption. Previous studies fail to confirm this finding, instead assuming the need to extend collaboration. Nevertheless, several studies introduce the idea of unfavorable relationships, which often exist between trading partners and make IOIS adoption difficult (Ham & Johnston, 2007; Kumar & van Dissel, 1996). This finding, however, applies to both short- and long-term unfavorable relationships, since the SMEs in the building sector only collaborate with well-known partners, often in long-term business relationships.

Possibly, trust and interpersonal (and physical) collaboration are traditionally the bedrock of these relationships. Thus, the introduction of IOIS as a mediation agent might weaken the existing link between collaborating firms. Hence, SMEs in the building sector are very reluctant to introduce innovations that may alter the existing service delivery system. Therefore, SMEs in the building sector will try to avoid changes in order to maintain the traditional links with providers and customers.

As a result, SMEs consider that IOIS could encourage innovation in the delivery system of already well-consolidated customer–supplier

Table 2
Structural model assessment.

Relationship		Year1	Year2	Year3	Year4	Year5	Year6
OC	$\mathbf{R^2}$	**0.88**	**0.75**	**0.52**	**0.98**	**0.95**	**0.96**
	$\mathbf{Q^2}$	**0.63**	**0.57**	**0.41**	**0.84**	**0.63**	**0.79**
$OC_S \rightarrow OC$	β	0.05(ns)	0.15[a]	−0.02(ns)	0.25[c]	0.38[c]	0.49[c]
$OC_C \rightarrow OC$	β	0.23(ns)	0.24[a]	0.18[a]	−0.04[a]	0.20[b]	0.21[b]
$OC_O \rightarrow OC$	β	0.51[c]	0.35[c]	0.50[c]	0.38[c]	0.33[c]	0.25[c]
$OC_T \rightarrow OC$	β	0.32[c]	0.35[c]	0.24[b]	**0.40[c]**	0.11[a]	0.07(ns)
IE	$\mathbf{R^2}$	**0.61**	**0.47**	**0.29**	**0.30**	**0.37**	**0.38**
	$\mathbf{Q^2}$	**0.40**	**0.28**	**0.19**	**0.19**	**0.21**	**0.23**
$IE_S \rightarrow IE$	β	0.52[c]	0.57[c]	0.40[c]	0.51[c]	0.58[c]	0.56[c]
$IE_C \rightarrow IE$	β	−0.22[c]	−0.21[b]	−0.21[b]	−0.11(ns)	−0.07(ns)	0.22[a]
$IE_O \rightarrow IE$	β	0.44[c]	0.34[c]	0.19[b]	−0.01(ns)	−0.04(ns)	−0.04(ns)
PB	$\mathbf{R^2}$	**0.91**	**0.83**	**0.60**	**0.82**	**0.79**	**0.74**
	$\mathbf{Q^2}$	**0.75**	**0.61**	**0.45**	**0.61**	**0.51**	**0.53**
$PB_S \rightarrow PB$	β	−0.09[a]	0.21[c]	0.40[c]	0.58[c]	0.57[c]	0.60[c]
$PB_C \rightarrow PB$	β	−0.35[c]	−0.28[c]	−0.26[c]	−0.26[c]	−0.28[c]	−0.23[c]
$PB_O \rightarrow PB$	β	0.68[c]	0.46[c]	0.31[b]	0.28[c]	0.24[c]	0.27[c]
$PB_T \rightarrow PB$	β	0.12[a]	0.12[a]	0.02(ns)	−0.00(ns)	−0.02(ns)	0.03(ns)
ITA	$\mathbf{R^2}$	**0.88**	**0.78**	**0.67**	**0.67**	**0.58**	**0.64**
	$\mathbf{Q^2}$	**0.77**	**0.62**	**0.49**	**0.44**	**0.30**	**0.41**
H1: OC → ITA	β	0.76[c]	0.71[c]	0.63[c]	0.72[c]	0.67[c]	0.83[c]
H2: IE → ITA	β	0.02(ns)	0.09(ns)	−0.14[a]	−0.02(ns)	0.14(ns)	0.15[a]
H3: PB → ITA	β	0.54[c]	0.45[c]	0.39[c]	0.46[c]	0.55[c]	0.52[c]

Data in bold refer to the values of R^2 (variance explained) and Q^2 (Stone-Geisser Q^2) for the second-order constructs (OC, IE, PB) and the endogenous construct (ITA).

[a] $p < 0.05$ level of significance for a one-tailed t(499)-student.

[b] $p < 0.01$ level of significance for a one-tailed t(499)-student.

[c] $p < 0.001$ level of significance for a one-tailed t(499)-student.

relationships, while failing to perceive IOIS as an adequate tool for building new customer–supplier relationships.

4.4. Technological IOIS features

The SMEs in the building sector still eschew technological IOIS features (i.e., ICTs) as a source of potential benefits. Public policy reports cite this finding as an important cause of the low penetration of ICTs in inter-organizational oriented business processes in this sector (Ecorys, 2008). Therefore, SMEs do not contemplate the potential of ICTs for innovation in services, mainly owing to two reasons: low development of e-skills and limitations in high-speed broadband Internet access. The major cause of these shortcomings lies not only in the low degree of e-skills, but also in the disparity of territorial, cultural, and social differences. In order to overcome these barriers, the EU has launched several initiatives within the Digital Agenda for Europe 2020 (European Commission, 2013) to develop ICT skills in enterprises.

ICTs help reduce costs, enable more efficient development processes and bring products to market more quickly than traditional methods (Chung et al., 2009). ICTs are especially important in services, since ICT allows for greater efficiency and effectiveness in information management, which is why most service innovations currently involve technology (den Hertog, 2000). Nonetheless, the fact remains that the SMEs in the building sector display a considerable lack of technological innovation. ICT skills are very important as a source of competitive advantage, and so the SMEs in the building sector should enhance innovation by using these tools.

5. Conclusions

The building sector is of great importance in today's economy, in both Spain and the broader European context. This research encourages further service innovation in this sector through the identification of the factors influencing IOIS adoption in SMEs as a source of competitive and collaborative advantage.

The main findings of this research are the four ways in which IOISs might contribute to service innovation in the building sector. Namely: a) improving client interfaces and the link between service provider and end users; b) defining a specific market where SMEs can develop new service concepts; c) enhancing service delivery systems in traditional customer–supplier relationships; and, d) introducing ICT tools to improve information management. In this way, an IOIS (e.g., an SCM system) should support these characteristics to bring about success in this sector.

On the downside, this study suffers from one noticeable limitation: the research sample only represents the region of A Coruña (Spain). Authors should therefore exercise caution when extrapolating this study's results to other regions. Further research should seek to establish a generalization of these findings in different geographic settings.

References

Ali, M., Kurnia, S., & Johnston, R. B. (2008). A dyadic model of interorganizational systems (IOS) adoption maturity. *Paper presented at the 41st Hawaii International Conference on System Sciences.*

ARDÁN-Galicia (2003–2013). *Directorio de empresas de Galicia informe económico financiero y de la competitividad [on-line].* : Consorcio de la Zona Franca de Vigo (http://www.ardan.es)

BIC-Galicia (2010). *Guía sectorial de la construcción.* Xunta de Galicia.

Campbell, D. T., & Stanley, J. C. (1966). *Experimental and quasi-experimental designs for research.* Boston: Houghton Mifflin Company.

Carbonell-Ureña, J. F. (2012). *Propuesta de un modelo de integración para la gestión de la cadena de suministro en el sector de la construcción.* (PhD Thesis). : Universidad Politécnica de Valencia.

Cepeda-Carrión, G., & Roldán-Salgueiro, J. L. (2004). Aplicando en la práctica la técnica PLS en la Administración de Empresas. *XV Congreso ACEDE* (Murcia 19-21 Septiembre 2004).

Chin, W. W. (1998). Issues and opinion on structural equation modeling. *Management Information Systems Quarterly*, *22*(1), vii-xvi.

Chung, J. K. H., Kumaraswamy, M. M., & Palaneeswaran, E. (2009). Improving megaproject briefing through enhanced collaboration with ICT. *Automation in Construction, 18(7).* (pp. 966–974): Elsevier Science Publishers.

Chwelos, P., Benbasat, I., & Dexter, A. S. (2001). Empirical test of an EDI adoption model. *Information Systems Research*, *12*(3), 304–321.

Coltman, T., Devinney, T. M., Midgley, D. F., & Venaik, S. (2008). Formative versus reflective measurement models: Two applications of formative measurement. *Journal of Business Research*, *61*(12), 1250–1262.

Criado-Fernández, M. (2000). *Caracterización de modelos de cooperación entre organizaciones como base para la obtención de estructuras flexibles y competitivas.* (PhD Thesis). : Universidad Politécnica de Madrid.

den Hertog, P. (2000). Knowledge intensive business services as co-producers of innovation. *International Journal of Innovation Management*, *4*(4), 491–528.

Ecorys (2008). *FWC sector competitiveness studies N° B1/ENTR/06/054—Sustainable competitiveness of the construction sector.* Directorate-general enterprise and industry. : European Commission.

European Commission (2013). Digital agenda for Europe. A Europe 2020 initiative. [on-line]. http://ec.europa.eu/digital-agenda

Falk, R. F., & Miller, N.B. (1992). *A primer for soft modeling.* Akron, OH: University of Akron Press.

Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research*, *18*, 39–50.

Gefen, D., & Straub, D. (2005). A practical guide to factorial validity using PLS-graph: Tutorial and annotated example. *Communications of the Association for Information Systems*, *16* (Article 5).

Hair, J. F., Anderson, R. E., Tatham, R. L., & Black, W. C. (1998). *Multivariate data analysis.* Englewood Cliffs, NJ: Prentice Hall.

Ham, Y. N., & Johnston, R. B. (2007). A process model of inter-organisational SCM initiatives adoption. In W. Chung Wang, M. Heng, & P. Chau (Eds.), *Supply chain management: Issues in the new era of collaboration and competition* (pp. 191–225). Hershey, PA: Idea Group Publishing.

Holland, C. P. (1995). Cooperative supply chain management: The impact of interorganizational information systems. *Journal of Strategic Information Systems*, *4*(2), 117–133.

Kim, K. K., Park, S. -H., Ryoo, S. Y., & Park, S. K. (2010). Inter-organizational cooperation in buyer–supplier relationships: Both perspectives. *Journal of Business Research*, *63*(8), 863–869.

Koch, H. (2005). Inter-organizational information system adoption and diffusion: A review and analysis of empirical research. In S. B. Eom (Ed.), *Inter-organizational information systems in the Internet age.* Hershey, PA: Idea Group Publishing.

Kumar, K., & van Dissel, H. G. (1996). Sustainable collaboration: Managing conflict and cooperation in interorganizational systems. *MIS Quarterly*, *20*(3), 279–300.

Kurnia, S., & Johnston, R. B. (2000). The need for a processual view of inter-organizational system adoption. *Journal of Strategic Information Systems*, *9*, 295–319.

MacKenzie, S. B., Podsakoff, P.M., & Podsakoff, N.P. (2011). Construct measurement and validation procedures in MIS and behavior research: Integrating new and existing techniques. *MIS Quarterly*, *35*, 293–334.

Markus, M. L., & Robey, D. (1988). Information technology and organizational change: Causal structure in theory and research. *Management Science*, *34*(5), 583–599.

Nøkkentved, C. (2009). *Enabling supply networks with collaborative information infrastructures.* (PhD Thesis). Copenhagen Business School (CBS).

Nunnally, J. C. (1978). *Psychometric theory.* New York: McGraw-Hill.

Orero-Giménez, A., & Criado-Fernández, M. (1999). El sistema de información interorganizacional como fuente y soporte de ventajas competitivas. *Paper presented at the IX Congreso Nacional de la Asociación Científica de Economía y Dirección de Empresa (ACEDE), Burgos, España.*

Pereira-Rama, A., Chaparro-Peláez, J., & Agudo-Peregrina, A. F. (2012). Caracterización de un modelo de sistema de información interorganizacional para el sector de la edificación domótica. *Iberian Journal of Information Systems and Technologies*, *10*, 81–96.

Ringle, C. M., Wende, S., & Will, S. (2005). SmartPLS 2.0 (M3) beta.